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The birth and routinization of IVF in China

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Abstract How can it be that China, with its history of restrictive family planning policies, is today home to some of the world's largest IVF clinics, carrying out as many as 30,000 cycles annually? This article addresses how IVF was developed in China during the early 1980s, becoming routinized at the same time as one of the world's most comprehensive family planning programmes aimed at preventing birth was being rolled out. IVF was not merely imported into China; rather it was experimentally developed within China into a form suitable for its restrictive family planning regulations. As a result, IVF and other procedures of assisted reproductive technology have settled alongside contraception, sterilization and abortion as yet another technology of birth control.

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Introduction

There is an almost precise coincidence of timing in the birth of Louise Brown in July 1978 and the implementation of China's restrictive family planning policy a few months later in 1979. These two landmark events stand at odds with each other in many ways. For Robert Edwards and Patrick Steptoe, the two doctors who helped Lesley and John Brown give birth to Louise using the technique of IVF, infertility was the problem that needed to be overcome. In contrast, for systems engineer Song Jian, mathematician Li Guangyuan and other architects of China's so-called 'one-child policy', excessive fertility was the problem that needed to be curbed

(Greenhalgh, 2008). The technique of IVF alone has brought an estimated 5 million babies into the world globally (of which some 200,000 in China, based on my best estimate after visiting various fertility clinics in the country¹) while it is said that the 'one-child policy' has prevented some 140 million births in China.

It is worth remembering that, as Martin Johnson and colleagues have shown (Johnson, 2011; Johnson et al., 2010), Edwards and Steptoe faced numerous setbacks during

¹ There is no official tally of the total number of IVF babies in China. China's largest clinic in Changsha had helped bring 73,461 IVF babies to term by March 2015.

the early days of their research on IVF in the UK. They were refused funding by the Medical Research Council in the early 1970s in a scientific climate where research into infertility 'was accorded a low priority' when compared with contraception and abortion (Johnson et al., 2010: 2158). Similarly, beginning in the early 1980s, reproductive scientists Lu Guangxiu, Zhang Lizhu and He Cuihua also faced many setbacks, albeit eventually securing government funding for their research in 1986, in a country where concerns about overpopulation were immediately national rather than global.

In her pioneering ethnographic research carried out in the early 1990s as a 'post-1980 consumer market for infertility treatment' was emerging in Beijing, anthropologist Lisa Handwerker showed how a growing use of assisted reproductive technology 'exacerbated the old social tension of reproducing the patrilineal line' (Handwerker, 2002: 306; see also Handwerker, 1995a,b, 1998, 1999). While the stigma that surrounds infertility and the pressure to do everything to overcome it was nothing new in China, through interviews with infertile women and men, Handwerker found that the one-child policy had in effect come to be experienced by couples as a 'must have one child' policy; with stories celebrating 'miraculous' test-tube babies circulating through media, couples, households and especially women felt an intensified stigmatization of childlessness. Handwerker had done her fieldwork in Beijing in the years immediately following the birth of China's first IVF baby in 1988. Even in these early days Handwerker described how 'clinics are overflowing with patients seeking out [assisted reproductive technology] services, and doctors are trying to keep up with the demand' (ibid.). As will now be shown, such trends have grown almost exponentially since, yet curiously we have seen no attention by social scientists to the routinization of IVF in China. More recently, Lijing Jiang (2015) has provided a historical account of Professor Zhang Lizhu's laborious efforts to achieve the birth of China's first IVF baby in the 1980s. There have also been a few anthropological studies of selective reproductive technology (SRT, used to prevent or allow the birth of certain kinds of children, such as those with Down syndrome, or a 'saviour sibling' or a boy) (Gammeltoft and Wahlberg, 2014) rather than assisted reproductive technology (used to overcome biological obstacles to reproduction) notably by anthropologists Jianfeng Zhu (2013), Suli Sui and Margaret Sleeboom-Faulkner (2010), Sui (2015). These scholars have provided accounts of how families engage with SRT such as carrier testing and prenatal screening in a national context where the state actively promotes improvement of population quality (*renkou suzhi*).

This article picks up on the early ethnographic work by Handwerker carried out in the 1990s as well as Jiang's historical work which focuses on the 1980s, firstly by broadening their geographical focus on Beijing to include the important work carried out by Lu Guangxiu in Changsha (capital of China's Hunan province) and secondly by extending the analysis to the present. As such, this article tracks the routes of development and routinization of assisted reproductive technology in China through the 1980s to the present with a specific focus on IVF. In doing so, it makes two arguments that are relevant for understanding how assisted reproductive technology has become a routinized part of healthcare delivery around the world.

Firstly, it argues that over the course of the last three decades, assisted reproductive technology in China has eventually settled alongside contraception, sterilization and abortion as yet another technology of birth control. While this might seem counterintuitive, this article shows how, following a period of trying experimentation, these technologies would have to mould into a suitable form to fit within China's restrictive reproductive regulations before gaining formal authorisation through national law as late as 2003. The term 'birth control' is most often used to describe fertile couples' active efforts to prevent unwanted pregnancies as a matter of (State-stipulated) family planning. However, if the term 'birth control' is understood as 'control over reproduction', it is argued that for increasing numbers of infertile couples in China, birth control can also describe an active effort to achieve wanted pregnancies using assisted reproductive technology to overcome biological obstacles in order to have 'one child' in strict accordance with family planning policies.

Secondly, this article argues that we need to re-centre our analyses when accounting for the routinization of assisted reproductive technology in different corners of the world such that we follow the transformation of such technologies from pioneering to mundane within a given country rather than across borders. As will be seen, the fact that IVF was developed in the UK did not relieve scientists of a need for experimentation in China, and hence we should not view this process as an 'importation of Western reproductive technologies' (Handwerker, 2002: 310; cf. also Inhorn, 2003). Indeed, if routinization has been a key ethnographic trope in social studies of reproductive technologies in Europe and America (see below), then globalisation has been a key ethnographic trope in social studies of reproductive technologies in the so-called global South (Bharadwaj, 2003; Hörbst, 2012; Inhorn, 2003; Roberts, 2012). With this article I call for a shift in analytical attention to the routinization of reproductive technologies in all countries, including those of the so-called South.

When it comes to medical technologies, 'routinization' indexes the transformation of a technology from frontier to mundane, as 'new technologies must traverse this continuum, changing from a status of pure experiment to the standard of care' (Koenig, 1988: 466). Barbara Katz Rothman (1993), Marcia Inhorn (1994, 2003), Lisa Handwerker (1995a,b, 2002), Sarah Franklin (1997; Franklin and Roberts, 2006), Rayna Rapp (2000) and Gay Becker (2000) have led the way in the social and ethnographic study of new reproductive technologies (both assisted and selective). They showed us how the development and routinization of technologies such as IVF, amniocentesis or prenatal genetic diagnosis (PGD), on the one hand, resulted from complex intersections within and between biomedical research, healthcare services, policy, social movements, popular media and more in a particular country, and on the other, turned them into an important part of the daily lives of providers, donors, patients and family members alike. Hence, building on their work, with the term routinization this article points, firstly, to socio-historical processes whereby certain forms of medical technology come to be (re-)produced and entrenched within particular juridical, medical, social, economic, cultural and institutional configurations. To account for the routinization of assisted reproductive technology, we

must trace the ways in which it took form in China. Secondly, it refers to all those daily practices through which certain medical technologies become an established and habituated part of healthcare delivery, which is to say a standard of care for a given condition provided in a fixed setting. There is a daily grind to the emergence of any medical technology, yet the particular ways in which these daily practices play out are different from country to country (not least because of said configurations), and indeed from hospital to hospital within countries. Finally, for a medical technology to become routine it must also be a normalised part of daily life, in the sense that it is available to and used by its intended users in a routine manner. As Becker has observed, 'when a specific medical technology is no longer viewed by medicine as experimental, that technological innovation may be increasingly accepted by the public and may eventually be viewed as commonplace' (Becker, 2000: 13). New reproductive technologies have tended to go through variegated patterns of 'acceptance' in different countries: starting from pioneering 'breakthroughs', surrounded or followed by periods of concern and resistance, then normalisation through regulation and eventually routinization as particular procedures are scaled up and made available. This article will in particular focus on the first aspect of routinization, namely, tracing the ways in which assisted reproductive technologies have taken on a particular form (cf. Knecht et al., 2012) in China on their way to becoming 'accepted'.

It begins by looking at how two of the pioneers of reproductive science in China – Lu Guangxiu in Changsha and Zhang Lizhu in Beijing – embarked on a collegial yet competitive race to achieve the country's 'first test-tube baby', culminating in the birth of two girls: Zheng Mengzu in March 1988 in Beijing, closely followed by Zhang Minging in Changsha three months later. It then goes on to show how the 1990s led to the emergence of an unregulated IVF sector in Beijing and many parts of the country, all the while Lu Guangxiu in Changsha was effectively prohibited from providing IVF services. Finally, it shows how IVF, alongside other assisted reproductive technologies, was eventually legalised in 2003 by the Ministry of Health, under the condition that 'medical staff are not allowed to conduct ART on people not qualified under... national population and family-planning legislation and policies' (P.R. China, Ministry of Health, 2003a,b: D1).

The article is based on interviews with some of the pioneers of reproductive technologies in China. Over a period of 8 years (2007–2014) I had the opportunity to speak to and interview Lu Guangxiu on numerous occasions in Changsha, the principle site of my fieldwork. Four of these interviews were recorded and transcribed. My requests for interviews with Zhang Lizhu were gently declined because of her advanced age. I was however able to spend time at, and speak to staff members of, the Third Hospital in Beijing where she had worked. A series of TV, radio and journal interviews with Zhang, available online, were transcribed and translated. They are referred to by number throughout. All other interviews were carried out by the author. The personal recollections of Zhang and Lu especially are used to narrate the story of the difficult birth and routinization of assisted reproductive technology in China. At the same time, their personal recollections are balanced against further

interviews with some of the other scientists involved in the development of assisted reproductive technology, as well as with Ministry of Health officials who were active in reproductive research and policy through the 1980s and 1990s, participation in a series of workshops and conferences on assisted reproduction in China held in Beijing, Shanghai and Changsha which gave insights into the history of assisted reproduction technology in these cities, and consultation of secondary archival sources. This research has taken place in the form of episodic fieldwork based at the CITIC-Xiangya Reproductive and Genetic Hospital in Changsha, the capital of Hunan province, over a eight-year period (2007–2014). Having worked with Professor Lu Guangxiu on a previous grant on the ethics of biomedical research collaboration (see Wahlberg et al., 2013), I was able to initiate this in-depth study of the routinization of IVF in China. The resulting dataset of interview transcriptions, scientific reports, media articles, laws and regulations forms the basis of the analysis that follows, as it is this data that has allowed me to piece together the routes of routinization that IVF has followed in China.

Origin stories

Scientific teams, clinics and indeed countries are often engaged in a race to be the first when it comes to 'new' or 'frontier' technologies; whether in the UK or in India there is prestige to be won from achieving a 'first' in the ever-growing field of reproductive technologies (Bharadwaj, 2002; Franklin and Roberts, 2006). Global 'firsts' (such as Louise Brown or Dolly the sheep) are perhaps the most prestigious, but by no means at the cost of national 'firsts'. In China, as already noted, two scientists have in particular been recognized, not least through national awards and prizes, as the pioneers of assisted reproductive technology – Zhang Lizhu of Beijing's Medical University Third Hospital and Lu Guangxiu of the CITIC-Xiangya Reproductive and Genetic Hospital in Changsha. If assisted reproductive technologies are completely routinized today in China, they were very much experimental technologies in 1980, which was a pivotal post-Cultural Revolution year for reproductive science in China. It was in 1980 that the Human Reproductive Engineering Research Department was founded at the Xiangya Medical College in Changsha by Lu Huilin, father of Lu Guangxiu. It was also in that year that Zhang Lizhu, a trained gynaecologist, returned to prominence as invited speaker on China's one-child policy and related public health issues at the United Nation's Second World Conference on Women held in Copenhagen.

Yet, Zhang and Lu arrived at assisted reproduction via very different paths, as endocrinologist and geneticist (by training), respectively. Having studied gynaecology in Shanghai, New York and Baltimore through the 1940s, Zhang took up her first position as resident gynaecological physician at the Marie Curie Hospital in London in 1949.² She returned to China in 1951, eventually becoming the Director of Gynaecology and Obstetrics at the Peking University Third

² For Zhang Lizhu's background story I rely on Jiang Lijing's extensive account (2015) as well as my own interviews with members of staff at the Beijing Third Hospital, attendance at workshops and archival sources.

Hospital in 1958. During the 1960s, her endocrinological research was focused on the increasing numbers of patients reporting menstrual irregularity in her clinic. By 1965, as the Cultural Revolution began, Zhang's international background was turned against her as she was demoted from her position as Director and sent to work in the countryside for a year where she trained so-called 'barefoot doctors', followed by a job as hospital janitor at the Third Hospital back in Beijing. Zhang was only able to resume her work as clinician and researcher in 1978 in a newly established endocrinology laboratory at the Third Hospital once the Cultural Revolution had ended. This change in fortune was directly linked to the Four Modernizations programme that Deng Xiaoping had launched that year to repair some of the many setbacks that agriculture, industry, defence and science and technology had suffered during the Cultural Revolution. Zhang picked up where she had left off, concentrating on her patients' menstrual irregularities, a specialisation that would inevitably draw her into the field of infertility, as she recalled in an interview with the Chinese Obstetrics and Gynaecology forum:

My expertise was in reproductive endocrinology. When I treated patients with period issues in the 1980s, I found that many of them not only wanted to cure their period problems, but also mainly wanted to get pregnant. A lot of them had been married for over two years but still couldn't get pregnant. Therefore, I began to look into what was causing their infertility. After research and analysis I found out it was due to blocked Fallopian tubes. In most cases this was the major problem. Blocked Fallopian tubes were mainly an issue in China, which was completely different from other counties. In China 31.3% of female infertility was caused by tuberculosis. We proved that they had tuberculosis through research and biopsy. So this cause was not necessarily the same as in other counties. The main clinical manifestation was pelvic adhesions, and the surface of the ovary couldn't even be seen.

(Interview 2)

Lu, on the other hand, was introduced to the field by her father Lu Huilin, one of the founders of medical genetics in China. Lu Huilin had travelled to the United States of America in 1924 to further his education at Columbia University, studying under Thomas Hunt Morgan and Edmund Beecher Wilson for a Master's degree in genetics. Armed with a number of Morgan's works, such as *Human Inheritance* (1924) and *Evolution and Genetics* (1925), Lu returned to China in 1929. Disrupted by illness and the Japan-China war (1937–1945), Lu eventually set about translating Morgan's texts in the late 1940s with a view to spreading Morgan's theories to a Chinese audience. In 1950, he published a book on the theory of the gene and Mendelian inheritance which he began teaching at the medical college in Changsha only to be widely criticised in a newly communist China which officially favoured Lysenkoist ideas around the heritability of acquired characteristics. Once again Lu's studies and teaching were interrupted as the Cultural Revolution took hold in the 1960s. As a result, he shifted his attention to medical genetics in the 1970s, forming a research group in Changsha that would develop prenatal diagnosis and genetic counselling techniques. It was this group that would be

formally institutionalised in 1980 as the Human Reproductive Engineering Research Department of the Xiangya Medical College. And so Lu Huilin's interest in reproductive technologies began to take shape. His initial excitement upon hearing news of Louise Brown's birth some months after the event in 1979 concerned the possibilities of utilising IVF not so much to overcome infertility but rather as a way of avoiding transmission of heritable diseases. It was at this time, in the late 1970s, that Lu Huilin's daughter, Lu Guangxiu, would unknowingly be enlisted in China's efforts to develop reproductive technologies. As she explained to me in her office surrounded by a forest of indoor plants one late afternoon in May 2011:

I was a surgeon in Guangdong in 1979, and at that time, because my father's health was not very good, I came back to Changsha to take care of him. During that time, he posed a question to me, asking: 'Do you know how we can get an oocyte?' I was astonished to get this question! Because I had never observed any oocytes during ultrasound and the technical equipment was also very poor at that time. So, as a surgeon I answered 'maybe you have to open the stomach to have this oocyte.' I also wondered why he would ask this question. When I came back to Changsha, I had become a teacher of anatomy. In those days, I could teach for half of the year and have my own time for the other half of the year. Being a surgeon was hectic every day, so I was used to the old busy days. So I felt I had too much free time and I hadn't many things to do. So I asked my father why he asked this question and he said that he would like to try for an IVF baby. I then said 'Why don't you let me have a try?' But my father said that I am a surgeon and so I lack basic knowledge of this research and he would think about it. After several days, he gave me some examples of what I would meet if I was going to be engaged in this research, such as the equipment, technology and knowledge, so all these things, I had to begin from scratch. 'You will encounter many difficulties and you have to overcome them', he told me. I thought about it and also accepted it and began the research.

And so, Lu Huilin sent his daughter to Beijing on a three-month study trip in 1980 to learn how to fertilize eggs and culture embryos from cows, rats and mice. Lu Guangxiu's sister was studying at Beijing University at the time and had many friends and classmates working at the Chinese Academy of Sciences in the field of genetics. So, whereas Zhang Lizhu's attention had been drawn to infertility by the patients she encountered as a clinical gynaecologist, Lu Guangxiu was introduced to reproductive science by her medical geneticist father whose initial interests focused on the use of reproductive technologies to engineer and improve the strength of China's population. This intersection of clinical infertility and medical genetics, as we will see, turned out to be propitious for the development of assisted reproductive technology in China.

Experimenting

As noted earlier, Zhang Lizhu travelled to Copenhagen to speak at the United Nations Women's Conference, yet

as she has explained, she did not learn about IVF at this point:

I went abroad in 1980 with some women's groups to visit many places. However, our visit at the time didn't consider test-tube baby technology at all. What we looked at was how to do female healthcare, how to do family planning – meaning abortions and birth control – as well as learning about condoms and intrauterine devices, therefore we didn't really keep up with the trends at the time.

(Interview 4)

As a result, once she did begin focusing her attention on the infertility problems of her patients which were affected by the epidemiological particularities of China, she would have to embark on her own forms of experimentation. Lu had been astonished when her father had asked her 'Do you know how to get an oocyte?' since she had worked as a surgeon rather than an obstetrician or gynaecologist. Zhang, on the other hand had experience from working with her patients. She recalls how she began working to locate and retrieve oocytes:

There were test-tube babies elsewhere in the world at this time. The first test-tube baby was born in 1978 in the UK. At that time they were all using laparoscopic surgery to retrieve eggs. Once the laparoscope was put in, the surface of the ovary could be seen, and the ovary follicle could be seen too, which was the place the needle needed to penetrate. However, in China we couldn't do the same because the surface of the ovary couldn't be seen at all using a laparoscope. So the only method we had at the time was retrieving ova by hand while treating pelvic cavity disease. Manually reaching the ovary follicle and judging by instinct to decide where to insert the needle, sucking the ovarian follicular fluid out and then finding the ova in the ovarian follicular fluid. Therefore, we used a different strategy by finding ova in the ovarian follicular fluid we retrieved, and learned more about the ova.

(Interview 2)

Jiang has argued that we should take this celebration of an 'indigenous method' with a grain of salt, since the fact was that laparoscopy was a difficult technique for anyone to learn, let alone in China where clinical and laboratory conditions were so poor in the early 1980s (Jiang, 2015: 13–14). Open pelvic surgery was not so much necessary in China at the time as it was familiar. Moreover, there were not many patients who were willing to undergo experimental procedures solely for egg retrieval.³ Instead patients were asked if they would agree to egg retrieval for research purposes once open pelvic surgery for a medical indication had been safely completed. On her part, Lu Guangxiu's initial attempts to secure oocytes during this time were also through surgery, because as she told me 'we didn't know how to do laparoscopy'. Zhang has

recounted how in these early years 'we [started] from not being able to identify ova' just as Lu has recalled 'I didn't know what the eggs look like at that time'. As a result, there was a lot of trial and error involved. For Lu, this involved countless trips to hospitals throughout Changsha which carried out surgery for the treatment of gynaecological disease to ask for assistance in getting oocytes:

Egg retrieval had been done in Xiangya hospital, however as they didn't support our work I was refused to go into the surgery room. I had to go to other hospitals for eggs. I sometimes rode a bicycle and carried a bucket as I visited many hospitals in Changsha. But I had little chance to get eggs, since sometimes we couldn't find follicles in ovarian tissues. Besides, it was also very hard for me to recognize eggs, as human eggs were different from mice eggs. That's why I set up a sperm bank at that time, because I couldn't tell whether the eggs were mature or immature when I got eggs, so I had to fertilize the eggs. So I set up a sperm bank in order to fertilize the eggs once I got them. Without ovulation induction, it was very difficult at that time.

Zhang on the other hand, was familiar with and had direct access to the departments at the Third Hospital which carried out routine open pelvic surgery for a variety of conditions. Yet, also she would have some trouble finding willing patients, and when she did there were numerous practical challenges related to timing operations such that they coincided with ovulation. Without a sperm bank in Beijing, Zhang relied on the husbands of her infertile patients to provide sperm samples, not all of whom agreed. Moreover, Zhang was also hampered initially by not having seen a human egg before, having only microscopically observed pig and mouse eggs. In this way, the early 1980s were truly experimental years for assisted reproduction in China. Those scientists who became interested in reproductive technologies had to devise ways of getting gametes in China, and were faced with at least as many (if not more) challenges in this as their colleagues anywhere else in the world.

Indeed, visiting China's gridlocked metropolises today it can be easy to forget just how much cities like Beijing and Changsha have transformed over the last 25 years. Following the Cultural Revolution, which ended in 1976, many laboratories had become almost derelict and there were no reliable suppliers of laboratory equipment or chemical agents. The bicycle was still the most common form of urban transportation. In recollections of the many difficulties they had faced, both Zhang and Lu convey a sense of pride and perhaps also nostalgia for the excitement of the times. Zhang has recalled how equipment shortages were a constant struggle when they were trying to develop egg retrieval techniques:

We described the difficulties we faced as 'poor and blank'. Conditions were really poor. All equipment had to be used repeatedly. For example, there were only a few ova-retrieving needles, which were brought back from overseas. They had to be washed and high-pressure sanitized. Vessels had to be used again and again too, and then washed and high-pressure sanitized. At that time we had a lot of cases but there were no infections. This was very impressive and staff in our laboratory worked really hard. There were whorls at the very top of the needles... which made it easy to know where to penetrate. The whorls were worn down. We took the needles to watchmaker shops to sharpen them. After

³ Today, ethical review boards have become a required obligatory point of passage for much biomedical research. In China, such procedures remain relatively new to the country (see Wahlberg et al., 2013) and there are certainly numerous questions that can be raised about the ethics of early assisted reproductive technology research in China. Such questions are of course equally relevant in every country where experimental assisted reproductive technology research has been carried out; whether in India, Denmark or the UK.

being sharpened and reused so many times we had to throw them away, since the whorls could barely be seen anymore. The conditions really were poor at the time.

(Interview 1)

Improving population quality

By 1984, Zhang had developed her own technique of egg retrieval, just as Lu had established China's first sperm bank and secured China's first child using frozen sperm. Up to that point, the two had operated without much knowledge of each other's work. That would change in late 1983 when an exhibition on 'superior births' (*yousheng*)⁴ was organised by the Family Planning Department of the provincial government in Hunan province. Participants at the exhibition discussed both 'negative' (primarily prenatal diagnosis followed by abortion) and 'positive' ways of improving population quality. Since preimplantation genetic diagnosis was a long way off at that stage, sperm banking was discussed as one possible method of improving population quality. A group of journalists who were attending the exhibition got wind that a sperm bank had in fact been established in Changsha:

They came here for an interview and then they sent out a report saying that in Hunan there is a sperm bank. This was kind of explosive news in China, because every newspaper carried this information and they kept reporting it, and suddenly we got very famous around China! [laughter] and we got hundreds of letters from patients and from other institutes. Although many people praised us, some people criticized us... they thought we were treating people like animals, since we are just collecting sperm.

Shortly after news of Changsha's sperm bank had broken nationally, Zhang Lizhu and Lu Guangxiu began communicating. Together with He Cuihua from the Peking Union Medical College (who had been introduced to assisted reproduction during a study trip to Singapore), the trio agreed to prepare an application for research funding which would be sent to the Ministry of Health. After some discussion between them, they agreed to title their application '*Yousheng*: The Protection, Preservation, and Development of Early Embryos', a decision that cannot be detached from the family planning measures that were being rolled out across China in this exact same period, as well as the growing interest in population quality on the part of Family Planning officials⁵ (Greenhalgh

and Winckler, 2005). As Zhang has put it 'there were other voices at the time. Some people said: China already has such a huge population, why do you still want to work on test-tube babies? They said this went against the national family planning policy.' (Interview 1). Similarly, when I asked Lu about the apparent contradictions of carrying out IVF research in China in the 1980s she replied 'there were many doctors and researchers who asked the same question as you did just now. So under this population policy and we are doing this kind of technology, something which is contradictory'. Moreover, as we saw earlier, Lu Guangxiu's route to reproductive science had been through medical genetics and her team at the Human Reproductive Engineering Research Department was as engaged in prenatal genetic testing as it was in IVF research. The medical genetic potentials of reproductive technologies had been at the very core of Lu Huilin's and Lu Guangxiu's early engagements with reproductive science. In the way in which their research application was framed, reproductive technologies emerged as techniques that could potentially contribute to the improvement of population quality in China (rather than being an infertility treatment as such), a demographic aim that had become a primary family planning objective alongside the controlling of population growth (Greenhalgh, 2008; Jiang, 2015; Sleeboom-Faulkner, 2010; Wahlberg, 2010).

If Zhang had succeeded in refining techniques to identify and retrieve human oocytes with the help of Liu Bin by 1984, having witnessed the great difficulties that his daughter was facing in trying to get gametes and equipment for fertilization research, Lu Huilin conceded in that same year. 'My father said that we can't go on like this, so he told the university that I need to have some training in foreign countries.' Arrangements were made for Lu Guangxiu and her colleague Xu Lili to travel to Yale University, a long-time partner of the Xiangya Medical College, in 1985. Lu was charged with learning laboratory procedures such as sperm washing, determination of the level of maturity of an egg, culture medium preparation as well as embryo morphology assessment, while Xu on the other hand received training in clinical procedures such as ovarian stimulation and egg retrieval. Six months later, the pair returned to Changsha bringing back with them as much equipment as they could carry including electronic scales, an osmotic pressure tester and even a bottle of ultrapure water: 'I came back in 1986 and established a laboratory immediately with all the equipment'. Now, one might be tempted to argue that clearly Lu Guangxiu, Zhang Lizhu and He Cuihua had received training and inspiration outside of China, hence perhaps this is after all a story of 'importing western technologies into China'. However, we know that, for example, Robert Edwards and Patrick Steptoe interacted with numerous international colleagues, and Steptoe travelled to France to learn laparoscopy from Raoul Palmer (Litynski, 1998), yet it is the UK that is most often 'credited' as the 'birthplace' of IVF. My point is that regardless of where they received training and where successful IVF was first achieved, Lu and Zhang had to experiment in order to develop it in China; they were not able to 'skip' experimentation and merely set about routinizing IVF. Moreover, in setting out to develop reproductive technologies in China they were responding to local concerns arising out of the clinic (in Zhang's case) as well as out of a growing interest in population quality on the part of

⁴ *Yousheng* is often translated as 'eugenics' but as noted above, it is more accurately translated as 'excellent' or 'superior' birth and is used to describe all efforts aimed at ensuring the birth of a healthy child, from genetic counselling to taking care of oneself during pregnancy, prenatal care and screening (Sleeboom-Faulkner, 2010; Wahlberg, 2010).

⁵ The debate over whether *yousheng* should be understood and directly translated into English as 'eugenics' has been ongoing ever since the government proposed a law on *yousheng* in 1994. The term is made of the two characters for *you* which translates as 'superior' and *sheng* which translates as 'birth'. The title of this law was later changed to the "Maternal and Infant Health Care law" not least as a consequence of international controversy, although the law clearly states that improving population quality through the prevention of congenital birth defects and serious genetic disease is a major objective. It is beyond the scope of this paper to contribute to this discussion. For ethnographic engagement with China's *yousheng* policy see, P.R. China (1994), among many others, Zhu (2013), Wahlberg (2010), Sleeboom-Faulkner (2010) and Sui (2015).

government officials (in Lu's case). As was the case with Edwards and Steptoe, Zhang and Lu built upon a range of already established procedures, technologies and lab equipment which were circulating through global flows of technology and knowledge as they developed IVF in China.

It was also in 1986 that the '*Yousheng*' research project would receive funding from the National Natural Science Foundation of China, which had been established under the auspices of the Four Modernizations programme. The Foundation awarded RMB 100,000 to be split between the three researchers and their laboratories. The amount was therefore hardly sufficient, although the recognition that came with being awarded such a grant was perhaps of even more importance as theirs became a so-called key research project of the Seventh Five-Year Plan. Reproductive science had become a part of China's overall modernization programme, just as the race to produce China's first IVF child was in effect on. This time, Zhang won. After thirteen attempted cycles with different women, 39-year-old Zheng Guizhen from Gansu became pregnant and gave birth to Zheng Mengzu on 10 March 1988 in Beijing: 'there were three hospitals at the time working on this... We were the first to produce test-tube babies' (Interview 1). In a television programme called 'Fendou' aired on China's CCTV network in August 2011, Zhang tells of her nerves on the scheduled day of Zheng Mengzu's birth by Caesarean section as the nation's eyes were fixed on her:

When the first test-tube baby was born, there were a lot of reporters waiting outside the operating room. So when I was on the way to the operating room I didn't really want to face them. I passed by with a blank face without even nodding at them, without a word, because I was worried. I was not worried about the operation. What I was worried about was the baby being born with some kind of malformation, such as a harelip. So this is what I was worrying about when I performed the surgery. Then I saw the baby and checked her whole body and she was totally fine, crying really loudly. I felt I could relax afterwards. They said at this point I looked happy, with a little smile. So I really didn't know how to cope with the media at the time. I should have talked to them a little bit, which I didn't do at all. (Interview 3)

It is telling that the health of Zheng Mengzu was foremost on Zhang's mind. Since Zhang, Lu and He had claimed that IVF was a technique that would contribute to 'superior births' (*yousheng*), it would have been a major setback had the child not been healthy. Meanwhile, in Changsha, yet another 'race' was playing out:

We didn't succeed for more than one year [after returning from Yale in 1986], so I worried much about that. The country had spent so much money on my training and there were a lot of expectations on me from others, especially from my father. He was 88 years old at that time, so I also hoped to succeed as soon as possible. However, I failed for over one year so that I felt a lot of pressure.

Changsha's first IVF babies were finally born three months after Zheng Mengzu in June of 1988. As it happened, two patients had had their eggs retrieved and fertilized around the same time in the second half of 1987. Once their

eggs had been fertilized with their respective husbands' spermatozoa, one of the patients had only very poor quality embryos while the other patient had surplus good quality embryos. However, since:

there was no freezing equipment and technology, we usually had to abandon the spare embryos. Instead, we asked her [the woman who 'only' had poor quality embryos] if she would like to accept the other couple's embryo, she said yes. Actually she was the first one who got pregnant in our centre... We don't know how we succeeded in the first one, maybe it's because we had done this work for a certain time and had gained some experience. However, the success rate at that time was still very low and it was probably less than 5%.

And so, Zhang Minxing, Changsha's first IVF baby (China's second) was born on the 5 June 1988, closely followed by Luo Youqun China's first embryo donation baby on the 7 June 1988. In all, a flurry of four IVF babies were born in 1988, two in Beijing and two in Changsha. Both Zhang and Lu had used open pelvic surgery to retrieve eggs in their first successful IVF cases. He Cuihua had used laparoscopic methods to try to obtain eggs and was ultimately unsuccessful in her quest for a 'first' IVF baby at the Peking Union Medical College in the late 1980s.

Legalisation

While the births of the first IVF babies in China were widely celebrated in the media as examples of China's indigenous scientific capabilities (Jiang, 2015), it would take a further fifteen years before assisted reproductive technology would finally be legalised and thereby authorised in China. Indeed, the 1990s turned out to be very different for Zhang than for Lu. In Changsha, provincial Ministry of Health officials had made it clear to Lu and her team that they were not in favour of assisted reproduction. They did have an interest in the potentials of SRT for improving population quality, but when it came to helping couples to have babies they felt that this was at odds with their systematic efforts to bring down fertility rates. As one scientist who had been working in Changsha at the time explained to me, some government officials 'had opinions about if we still have this kind of technology, then we will increase the population and because of this, Hunan province also issued a regulation to prohibit artificial insemination technology.' Indeed, on 3 December 1989, reproductive technologies were targeted for the first time in Hunan's provincial Family Planning Regulations, issued at the twelfth meeting of the Seventh People's Congress Standing Committee of Hunan in Changsha. The preamble of these regulations state that the overall objective of family planning in Hunan is 'to control population growth and improve population quality [through] late marriage and childbearing with *yousheng* births' (Hunan, 1989: §1.1, 1.3). Article 25 specifically prohibits 'fetal sex identification for pregnant women' and 'artificial insemination', the latter of which was included as a direct consequence of the national media notoriety that Changsha had attained for having China's first sperm bank as well as for delivering two IVF babies. No other provinces would legally ban assisted reproduction in this way. The impact that this regulation had was immediate.

The Xiangya Medical College forbade Lu and her team from continuing to work with patients, and so for most of the 1990s, reproductive research and experimentation in Changsha was confined to animals and basic research.

In stark contrast, Zhang was able to continue developing assisted reproductive technology treatments in Beijing as her stature had grown immensely following the birth of Zheng Mengzu and she continued to receive support from the central government. Zhang's achievement had been celebrated widely in the media as an example of indigenous scientific capacity (Jiang, 2015). As I learned from Qiao Jie, Director of the Medical Centre for Human Reproduction at the Third Hospital who worked under Zhang in the 1990s, Zhang went on to deliver China's first frozen embryo baby as well as China's first baby through gestational surrogacy in the first half of the decade. By 1993, some 50 IVF babies had been born in China, mostly in Beijing. Yet Zhang would still have to justify her work to those colleagues, government officials and journalists who:

asked how the country benefited from test-tube babies. Of course it was hard to say what benefit it brought to the country. However, people are part of this country. There is no country if there are no people. Test-tube babies brought happiness to many people. If people have a need like this, then we should fulfil it for them. People did have this need, and some of them needed it urgently. We received 6,300 letters from people who were infertile [in the years following Zheng Mengzu's widely publicised birth]. We analysed these letters and a lot of them had really hard lives: lots of people had extremely low self-esteem; the relationship between husband and wife was really bad; some divorced; some had family conflicts and didn't work anymore. This affected society's harmony, and this is in the end related to the country. (Interview 1)

Back in Changsha, Lu Guangxiu had not given up her hopes of establishing a fertility clinic, and as the decade wore on, the increasing growth of assisted reproductive technologies in the rest of the country would lead to a lifting of the ban on artificial insemination in Hunan. Clinics were being established throughout China in the 1990s. One reproductive scientist I interviewed in Changsha suggested that, 'some experts also said that 1997 was a Chinese IVF year because in that year, many centres appeared at the same time. So these centres were also kind of promoting the development of IVF technology'. Bolstered by these developments, Lu and her team continued to lobby provincial government officials in Hunan to get them to change their position on assisted reproduction. Meetings and workshops were organised in Changsha with the participation of local family planning officials, Ministry of Public Health representatives as well as legal advisers. Lu explained her tactics at these meetings:

I told them that my opinion is that the population policy requires that every family has only one child, but this is for fertile couples then you have one child. But for infertile couples we should also help them to have one healthy baby. So this is the real population policy. So I told the Family Planning bureau in Hunan that our population policy should be based on this idea that every family should have one healthy baby, not only fertile, but also infertile couples, so this is fair to every family. (see also Wahlberg, 2014)

On 3 August 1999, Hunan's Family Planning regulations were amended. This time Article 23 stated 'artificial insemination is prohibited, with the exception of institutions approved by the nation for scientific research, and those approved by family planning administration departments of the provincial people's government' (Hunan Province, 1999). But it was not only Family Planning and Ministry of Health authorities in Hunan that had taken note of the growing yet-unregulated assisted reproductive technology sector in China. During one of my stays in Beijing as a Visiting Scholar at the Peking University Health Science Centre in 2007, just opposite the fertility clinic at the Third Hospital, I interviewed one of the Ministry of Health officials in Beijing who coordinated the drafting of national regulations for assisted reproductive technologies. I was told how:

We carried out a survey in 1999 where we found out that about 200 centres were offering assisted reproductive technologies, but the standards were not good and they were not regulated. This was not acceptable. That's why we decided to put an expert group together to prepare regulations for these technologies, so that these clinics would require a license to provide assisted reproductive technologies.

And so it was, as the Ministry of Health issued a set of laws, regulations and technical specifications during the period 2001 to 2003 that would finally legalise assisted reproductive technology nationally. These included the Regulation on Assisted Reproductive Technology and Ethical Principles for Human Assisted Reproductive Technology and Sperm Banks, both of which were issued in 2001 and revised in 2003. With these regulations, assisted reproduction had finally settled into a form that suited the country's reproductive regulations. Henceforth, clinics providing assisted reproductive technology would have to live up to a series of strict requirements in order to be licensed. Apart from a number of technical requirements concerning the equipment, procedures and personnel that clinics must have, what made these regulations distinctive to China was the following passage:

Organizations operating IVF-ET [embryo transfer] and related technologies, must obey national population and family-planning legislation and policies... Organizations must first carefully inspect a couple's ID, marriage certificate and original copy of their qualification of pregnancy certificate issued under national population and family-planning legislation and policies. Photocopies of the mentioned documents should be saved for the records. (P.R. China 2003: B1, B2)

As a result, IVF and other assisted reproductive technologies (such as insemination and gamete intra-Fallopian transfer) are now only available to couples who have both a marriage certificate and a pregnancy certificate. The impact of the 2003 revised regulations on assisted reproductive technology was immediate. Only 90 of the 200 or so clinics that were providing assisted reproductive technology at the time were able to match the licensing requirements stipulated in the regulations. The regulations also served to normalise the practice of assisted reproductive technology. This normalisation was vividly on display in the lobby of one of the provincial Family Planning hospitals that I visited. The

hospital's directory was displayed on a large billboard which confirmed that among the services on offer were IVF, human sperm bank, prenatal screening, ligation operations, ligation reversal operations as well as pregnancy terminations. In this way, assisted reproductive technology has become but one among many other techniques of birth control which aim to control population growth and improve population quality in China.

Scaled-up IVF

Since 2003, the number of clinics providing assisted reproductive technology under license has steadily climbed back to and surpassed the 200 that the Ministry of Health had identified in their 1999 survey. By 2014, an estimated 400 centres were offering assisted reproductive technology services. In Beijing, the number of IVF babies has skyrocketed from the 50 reported by Handwerker in the early 1990s to more than 10,000 in 2011. In 2002 in Changsha, Lu and a group of investors formed the CITIC-Xiangya Reproductive Genetic Hospital which has exponentially increased the number of IVF cycles annually from 2,000 in 2003 to 30,000 in 2014. Scaled-up IVF is now a reality in China with profound implications for the ways in which the logistics of IVF are organized and patients experience their treatments. Growth continues to be driven both by insatiable demand (in Beijing and Changsha, huge crowds congregate every morning hoping to register as patient-customers) and because assisted reproductive technology has become a very lucrative sector with private investors providing much of the capital required to get started and/or expand.

According to Ministry of Health statistics, in 2013 there were a total of 609,009 assisted reproductive technology cycles carried out in China (including artificial insemination by husband: 91,725; artificial insemination by donor: 30,229; IVF: 221,025; intracytoplasmic sperm injection (ICSI): 98,935; and frozen embryo: 167,095). These cycles resulted in 193,863 pregnancies in 2013 and there were 145,108 live assisted reproductive technology births in that year too. The estimated cost per IVF cycle is 20,000 to 30,000 RMB while for ICSI it is 25,000 to 35,000 RMB per cycle. Fertility treatment is not covered by public or private insurance which means that for many infertile couples in China, assisted reproductive technology remains out of reach.

In one of the newest fertility clinics I visited in China, the IVF laboratory was surrounded by no fewer than four egg retrieval/embryo transfer theatres, each with a hatch into the laboratory. On my tour of these facilities when I asked what couples did with any so-called 'spare embryos' if they succeeded in having a child, given the then one-child policy, one of the embryologists exclaimed that 'our tanks are bursting!'. As it happens, many couples had been (cryo-)banking on a change in family planning regulations as indeed did happen in late 2015 when all couples were given permission to have two children, changes that made these frozen embryos bureaucratically viable for the first time. While the scale of assisted reproductive technology in China may appear enormous to most, it does not seem out of place when compared with other forms of health delivery

and hospital care in China. If we accept estimates that some 10% of couples of childbearing age are having trouble conceiving without assistance in China, the maths speaks for itself.

Conclusion

In the space of three decades, IVF in China has gone from experimental to routinized on an astounding scale and it has traversed the continuum from experimental to standard care within the country. It is absolutely the case that Zhang, Lu and others had received training and inspiration internationally, but in no way did this training allow them to 'merely' introduce and adapt an already existing technology to fit China's social, cultural, legal and socio-economic situation. Even if IVF had been invented and developed in isolation in the UK in 1978, it was not a case of simply importing a pre-existing technology into China; rather, bound up in global flows of knowledge and technology (much like all other scientists in the world), Zhang and Lu experimented in conditions that were extremely crude in comparison to those found in Europe in the 1970s. Following this experimentation in the 1980s, it would take almost two decades before IVF was officially accepted and sanctioned through assisted reproductive technology legislation amidst much resistance and scepticism on the part of government officials as well as fellow scientists. Since assisted reproductive technology was shaped into a suitable form via the 2003 regulations requiring couples to present clinics with their 'qualification of pregnancy certificate', we have seen a globally unprecedented scaling up of assisted reproductive technology in China. Notwithstanding this growing sector, clinics simply cannot keep up with demand. Yet, as I have shown in this article, the routinization of assisted reproductive technology has by no means been self-evident or an unavoidable consequence of globalisation. Lu, Zhang and other reproductive scientists were not somehow 'adapting' a western technology; instead IVF emerged in China in response to local concerns (not least tuberculosis-induced infertility and a governmental push to improve population quality) in a way that makes it best understood as a technology of birth control.

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Interviews

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